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Within-person analysis of developmental cascades between externalising and internalising problems

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Running head: WITHIN-PERSON CASCADES

Abstract

Background: In a large body of previous research, cross-lagged panel models (CLPMs) have been used to provide empirical support for developmental models that posit a cascade from externalising to internalising problems. These developmental models, however, arguably refer to within-person processes whereas CLPMs provide a difficult-to-interpret blend of within- and between- person effects.

Methods: We used autoregressive latent trajectory models with structured residuals (ALT-SR) to evaluate whether there is evidence for externalising to internalising cascades at the within-person level when disaggregating between- and within- person effects. We used 8 waves of data (age 7 to 15) from the Zurich Project on Social Development from Childhood to Adulthood (z-proso).

Results: ALT-SRs fit better than the corresponding CLPMs. Using an ALT-SR model, we found evidence for externalising-to-internalising cascades, consistent with previous CLPM studies. However, we also found some evidence for effects in the ALT-SR that were not apparent in the CLPM, including a negative effect of externalising on internalising problems in adolescence. In addition, a negative effect of internalising on externalising problems in adolescence was found in both the CLPM and ALT-SR.

Conclusions: Within-person results were largely consistent with previous evidence from CLPMs; however, at the within-person level, externalising and internalising may negatively influence one another in adolescence.

Keywords: Externalising disorder; Internalising disorder; Comorbidity; Developmental psychopathology; Longitudinal studies

Externalising and internalising problems have a strong tendency to co-occur from childhood (Martel et al., 2017; Rhee, Lahey, & Waldman, 2015). Understanding the nature and cause of their co-occurrence is important for informing interventions. For example, identifying whether there are reciprocal or directional causal relations between the two domains and how these links are mediated provides key information on intervention targets. To date, developmental cascade models have proven valuable in illuminating the developmental relations between internalising and externalising symptoms. However, support for the developmental processes implied by these models has typically relied on statistical methodologies that arguably have not adequately operationalised said processes. In particular, typically utilised cross-lagged panel models (CLPMs) cannot disaggregate between- and within-person processes and their parameters reflect a difficult-to-interpret blend of the two. In this study, we apply autoregressive latent trajectory models with structured residuals (ALT-SR; Curran, Howard, Bainter, Lane, & McGinley, 2014) to more appropriately operationalise hypotheses regarding the developmental basis of externalising and internalising comorbidity.

Several developmental cascade models have been proposed to account for the association between externalising and internalising problems from childhood (see e.g., Moilanen, Shaw, & Maxwell, 2010 for a helpful summary). Though there are some exceptions (e.g., Lee & Stone, 2012; Weeks et al., 2016) the weight of evidence suggests that while externalising problems are liable to lead to the development of internalising problems, the reverse is generally not true. This evidence supports developmental models such as the dual failure model (Capaldi, 1992), which proposes that externalising problems create difficult psychosocial conditions (e.g., academic failures and peer problems) that increase the risk of anxiety and depression.

Typical studies in this area have utilised repeated measures data over several years of child/adolescent development. CLPMs (with or without mediators) are fit to the data and the (direct or indirect) cross-lagged paths between internalising and externalising examined. For

example, Blain-Arcaro & Vaillancourt (2017) recently examined aggression-depression cascades across 7 waves during adolescence using data (n=643) from the *McMaster Teen Study*. They found significant and positive cross-lagged paths from aggression to depression but did not find significant paths from depression to aggression. Similarly, van Lier et al. (2012) used CLPMs to evaluate the longitudinal mediation of the relation between externalising and later internalising by peer victimisation and academic failure. Using a sample of n=1558 Canadian children measured between ages 6 and 8, they found evidence for an externalising-to-internalising pathway but not the reverse. The pathway was mediated by academic underachievement.

As several authors have recently pointed out, however, despite their contributions to advancing theory in developmental psychopathology, CLPMs ultimately yield parameters that represent an aggregation of between- and within-person effects (Berry & Willoughby, 2017; Curran et al., 2014). Developmental models of psychopathology, however, typically refer to within-person processes (or separate within- and between-person processes) thus creating a mis-match between theoretical model and statistical operationalisation. Arguably this issue applies to the developmental models that seek to explain externalising and internalising comorbidity. This can be illustrated using the example of the dual failure model. It holds that externalising problems lead to problems in the social and academic domains. Specifically, acting out is proposed to lead to poor academic performance and issues with peers, such as rejection and victimisation. These issues, in turn, are proposed to negatively impact self-esteem, making it more likely that an individual will develop internalising problems. The model implies that if an individual shows an increase in their externalising behaviour, this will ultimately lead to an increase in their internalising problems. Although it may occur in the context of between-person differences in externalising and internalising, this developmental process occurs within, and not between individuals. Substantively, this would have quite different meaning to a between-person association between externalising and internalising. A between-person association could

reflect, for example, risk factors with a stable component that differs across children (e.g., the effects of genes, adversity, social disadvantage, family discord, maladaptive parenting) that result in higher levels of both externalising problems and internalising problems. Previous studies utilising CLPMs blend these between-person sources of variation with within-person effects, obscuring the latter.

From a clinical perspective, knowing whether there are within-person effects of externalising on internalising problems is important for informing interventions. If a child is liable to develop internalising problems as a result of externalising problems (a within-person effect), then important targets for intervention lie in the pathways that link externalising problems to internalising problems (e.g., the academic, peer and self-esteem problems referred to in the dual failure model). However, if the previously observed cross-lagged effects of externalising on internalising problems reflect influences that vary between individuals but that are relatively stable over time (e.g., social disadvantage, genes with early effects on externalising and later effects on internalising; Wertz et al., 2015), then alternative intervention targets are likely to produce better effects.

A solution to the blending of between- and within-person effects in the CLPM is to employ the recently proposed autoregressive latent trajectory model with structured residuals (ALT-SR; Curran, Howard, Bainter, Lane, & McGinley, 2014). The ALT-SR represents an extension of the parallel process model, whereby a cross-lagged (or other) structure is fit to the time-specific residuals from a parallel process latent growth curve model. This specification disaggregates the between- and within-person relations between two constructs, with the cross-lagged effects on the residuals capturing the reciprocal within-person relations between the constructs. Unlike the CLPM, the ALT-SR thus partials out the effects of unmeasured between-person confounds (Berry & Willoughby, 2017).

Previous investigations using the ALT-SR and closely related models have suggested that issues deriving from the blending of within- and between- person effects in the CLPM are

not merely a problem in principle. Berry and Willoughby (2017) illustrated the issue in a simulation study in which they showed that a substantively important and significant cross-lagged effect could be driven by a between-person effect in the absence of a true within-person effect. They also re-examined the relations between corporal punishment and aggression in data from the *Family Life Project*. They found a non-significant within-person effect of corporal punishment on aggression, despite a significant cross-lagged effect. These results thus challenge the long-held belief that corporal punishment leads to increases in aggression; their association may instead reflect confounding factors such as gene-environment correlations or other factors that vary between parent-child dyads. Similarly, Besemer, Loeber, Hinshaw, & Pardini (2016) examined the within-person relations between maladaptive parenting and child externalising problems. Despite previous research supporting reciprocal relations consistent with 'coercive cycle' models (Patterson, 1982), they found no relations between dimensions of parenting and child behaviour problems in their within-person analysis of data from the *Pittsburgh Youth Study.*

When evaluating developmental relations between externalising and internalising problems, it is also important to consider gender differences in psychopathology. Although it is relatively well-established that internalising problems tend to be more common in females (from adolescence, where gender differences tend to emerge) and that most forms of externalising problems tend to be more common in males (e.g. Archer, 2004; Bongers, Koot, Van der Ende, & Verhulst, 2003; Demmer, Hooley, Sheen, McGillivray, & Lum, 2017), the evidence on gender differences in their developmental relations is mixed. While many studies have found no or few gender differences in developmental cascades involving externalising and internalising (Blain-Arcaro & Vaillancourt, 2017; Burt & Roisman, 2010; Hoglund & Chisholm, 2014; Lee & Stone, 2012; van Lier et al., 2012), a few have reported differences (Klostermann, Connell, & Stormshak, 2016; Leadbeater & Hoglund, 2009; Obradović et al., 2009; Wiesner, 2003). There is, for example, some evidence that females may be more likely to

exhibit cascading effects from internalising to externalising problems (Klostermann et al., 2016; Wiesner, 2003) and other evidence that the pathway from externalising to internalising problems may be stronger in males (Leadbeater & Hoglund, 2009).

Given the importance of establishing whether previously identified cross-lagged effects of externalising on internalising problems hold at the within-person level, we applied the ALT-SR to evaluate the within-person relations between externalising and internalising in a large longitudinal study, stratifying analyses by gender. Data came from the *Zurich Project on Social Development from Childhood to Adulthood* (z-proso) study, with n=1572 participants and externalising and internalising problem data at ages 7, 8, 9, 10, 11, 12, 13 and 15. Based on the dual failure model, we hypothesised that within-person effects of externalising problems on internalising problems would be observed for both males and females.

Method

Participants

Participants were 810 males and 761 females comprising the z-proso sample (documented at: https://www.jacobscenter.uzh.ch/de/research/zproso.html). Teacher-reported externalising and internalising problem data were collected when the children were of median age 7, 8, 9, 10, 11, 12, 13, and 15. At baseline, sampling occurred at the school level, with all children entering one of 56 schools invited to take part. Schools were selected according to a stratified random sampling procedure with stratification on school size and location. The initial target sample size was n=1675, with n=1572 participants contributing data to at least one measurement wave. Unit non-response has been analysed in a previous publication (N. L. Eisner, Murray, Eisner, & Ribeaud, 2018). These analyses suggested that children whose primary caregiver did not speak German as their first language were likely to be under-represented in the sample. However, the sample appeared otherwise reasonably representative of the underlying same-aged population. Further details of the recruitment, assessment,

recontact, and measurement protocols for z-proso can be found in previous publications (e.g., M. Eisner & Ribeaud, 2007).

Ethical Considerations

Ethical approval was obtained from the Ethics Committee from the Faculty of Arts and Social Sciences of the University of Zurich. Active informed consent was obtained via parents up until age 12, after which active informed consent was obtained from the youth themselves (parents could opt their child out of the study up to age 18.)

Measures

Externalising and *internalising problems* were both measured using the teacher-reported *Social Behavior Questionnaire* (SBQ; Tremblay et al., 1991). Externalising was measured with 6 items covering symptoms of oppositional defiant disorder and non-aggressive symptoms of conduct disorder, and 9 that measured aggression. Internalising was measured using 3 items covering anxiety and 4 that covered depression.

Adding to existing evidence for the favourable psychometric properties of the SBQ (e.g., Tremblay et al., 1991) the psychometric properties of the SBQ in the current sample have been investigated in previous publications, providing support for the reliability and validity of its scores (e.g., Murray, Obsuth, Eisner, & Ribeaud, 2017).

Using the items from the SBQ, longitudinal factor models were fit separately for internalising and externalising and used to estimate factor scores. Briefly, externalising and internalising were specified as unidimensional. Residual covariances between items measured at different time points were freely estimated. Models were fit in lavaan in R statistical software using FIML estimation to deal with missingness. FIML provides unbiased parameter estimates provided that data are missing at random i.e., missing conditional on the modelled predictors/covariates (MAR; Rubin, 1976). It is not possible to test MAR against not missing at random (NMAR) missing mechanisms because this requires information about the unobserved

data; however, there were several reasons to assume that any bias due to NMAR would be minimal. Non-response and attrition rates were relatively low (94% participation, 92% retention), there were few differences between the non-respondents and respondents at baseline (N. L. Eisner et al., 2018), and data on individuals who were missing at some waves were included in the model through the use of FIML. Factor scores were estimated using the Bartlett method. Omega reliability coefficients (McDonald, 1999) for all factors were >.90. This two-step method of first estimating factor scores in a separate step (rather than specifying latent internalising and externalising factors in the main substantive models) was used to facilitate estimation given the complexity of a model that incorporates latent variable measurement models in the ALT-SR model.

Informants

Participants' teachers completed the SBQ. For most of the youth in the sample, the same teacher provided ratings between grades one and three, i.e., at the measurement waves when the participants were aged 7, 8, and 9. Children were then taught by another teacher between grades four to six; i.e., at the measurement waves at age 10, 11, and 12. The youth then transitioned to secondary school for the data collection waves at ages 13 and 15. For the first three waves of data collection, teachers were not compensated for their participation but for all others teachers who had at least seven participants in their class received a book voucher worth approximately 50 USD.

Statistical Procedure

Developmental relations between externalising and internalising problems were assessed using an ALT-SR model. For the latent growth curve model part of the model, intercept and linear slope factors were defined for both internalising and externalising. The intercept factor loadings were all fixed to 1. The slope factor loadings for observations at waves 1 to 8 (ages 7 to 15) were fixed equal to 0, 0.095, 0.214, 0.395, 0.504, 0.629, 0.781 and 1,

reflecting the spacing of waves in time. Slope and intercept factor means and intercept factor variances were freely estimated and slope factor variances were fixed to 0. The intercept factors were allowed to covary. A cross-lagged structure was fit to the time-specific residuals of the growth curve part of the model. That is, internalising and externalising at each time point were regressed on internalising and externalising at the previous time point. (Residual) covariances between internalising and externalising at each time point were also included. For comparison, a standard CLPM was fit to the raw (non-residualised) factor scores. CLPMs and ALT-SRs were compared using the Bayesian Information Criterion (BIC). Smaller (more negative) BIC values indicate better-fitting models. In addition, when BIC differences are greater than |10|, the difference can be considered 'very strong' evidence in favour of the better fitting model (Raftery, 1995).

To examine gender differences, we fit ALT-SR and CLPMs in which all parameters were fixed equal across males and females. We compared these to the corresponding models in which the minimum necessary constraints for identification were imposed. If the BIC was better in the unconstrained model, modification indices and expected parameter changes were used to guide the iterative release of cross-gender equality constraints until a partially invariant model (with a BIC superior to both the fully constrained and unconstrained models) could be achieved.

All models were fit in *MPlus 8.0* using robust maximum likelihood estimation (MLR) with clustering by wave 1 teacher. Wave 1 teacher was used as the clustering variable because clustering effects were strongest in the earlier waves. This clustering also largely captures clustering at waves 2 and 3 because most children retained the same teacher across these waves.

Results

The ALT-SR with cross-gender equality constraints showed reasonably good fit (CFI=.90, TLI=0.90, RMSEA=.06, SRMR=.11, BIC=-5732.47) and better fit than the

corresponding CLPM (CFI=.86, TLI=0.84, RMSEA=.08, SRMR=.14, BIC= -5165.39). However, the unconstrained ALT-SR model fit better than the ALT-SR model with gender invariance constraints (CFI=.95, TLI=.93, RMSEA=.05, SRMR=.05, BIC=-6085.16). The unconstrained ALT-SR also fit better than the corresponding CLPM (CFI=.90, TLI=.85, RMSEA=.07, SRMR=.10, BIC=-5561.42).

Iterative release of cross-gender equality constraints from the ALT-SR model with cross-gender equality constraints gave a partially invariant model with good fit and superior fit to both the fully constrained and fully unconstrained models in terms of BIC (CFI=.94, TLI=0.93, RMSEA=.05, SRMR=.06; BIC=-6170.75). This model relaxed the cross-gender equality constraints on the within-person residual variances of externalising at ages 10, 11 and 12, as well as the cross-gender constraint on the intercept factor variance for externalising. None of the within-person autoregressive or cross-lagged parameters constraints had modification indices or expected parameter changes indicating a need for their removal. For comparison, an analogous CLPM was estimated but it showed poorer fit than the ALT-SR (CFI=.89, TLI=0.88, RMSEA=.07, SRMR=.12, BIC=-5536.90). The partially invariant ALT-SR model was thus accepted as the best model although it is worth noting that all ALT-SRs fit better than the corresponding CLPM with |BIC|>10, supporting the superiority of the ALT-SR in capturing the developmental relations between externalising and internalising problems in general. It is summarised in Table 1, which also includes the autoregressive and cross-lagged effects from the corresponding CLPM for comparison. Results from the partially invariant ALT-SR are also shown in Figure 1. For clarity, only autoregressive and cross-lagged paths are shown. Results suggested that with only a couple of exceptions externalising and internalising showed moderate to strong within-person stability. There was generally no within-person cross-lagged effect of internalising on externalising, with the exception of a negative cross-lagged effect between ages 12 and 13. However, there was a relatively consistent cross-lagged effect of externalising problems on internalising problems. A descriptive comparison of the ALT-SR and CLPM

231 suggested strong similarity of results. There were two main differences. First, internalising
232 showed low within-person stability between ages 9 and 10 in the ALT-SR but moderate stability
233 in the CLPM. Second, the ALT-SR revealed a negative within-person effect of externalising at
234 age 13 on internalising at age 15.

235 **Discussion**

236 In previous studies, applications of CLPMs have supported developmental cascade
237 models such as the dual failure model which posit that externalising-internalising comorbidity
238 can be explained in part because externalising creates risk for the development of internalising
239 symptoms. However, here we argue that a more appropriate operationalisation of this
240 hypothesis would involve examining within-person developmental relations between
241 externalising and internalising. Thus, it was the aim of the current study to utilise the ALT-SRs
242 to evaluate whether prior conclusions regarding externalising-internalising developmental
243 relations hold at the within-person level. Our ALT-SRs fit better than the corresponding
244 CLPMs, supporting the idea that ALT-SRs are more suitable for capturing externalising-
245 internalising relations over developmental time. Our within-person analyses from our ALT-SR
246 largely replicated the finding that externalising predicts later internalising in childhood.
247 However, results also suggested that internalising and externalising problems negatively
248 influence one another in adolescence, with internalising at age 12 negatively predicting
249 externalising at age 13 and externalising at age 13 negatively predicting internalising at age 15.
250 The latter effect was only revealed in the ALT-SR with between-person variance partialled out.

251 The ALT-SR results were largely in line with previous investigations using CLPMs in
252 that in childhood, they suggested positive cross-lagged effects from externalising to
253 internalising but no cross-lagged effects in the opposite direction (Hoglund & Chisholm, 2014;
254 Leadbeater & Hoglund, 2009; Moilanen et al., 2010; van Lier & Koot, 2010; van Lier et al.,
255 2012). These results bolster support for models that posit developmental cascades from
256 externalising to internalising in childhood. Dominant among these models is the dual failure

model (Capaldi, 1992) which proposes that externalising-to-internalising pathways are mediated by failures in the academic and social domains. However, others have proposed alternative mediators, such as parental issues (Wertz et al., 2015). It would be valuable for future studies to evaluate whether proposed mediating mechanisms also hold at the within-person level.

Beyond age 12, however, our results suggested a potential protective effect of internalising although it was limited to a significant negative cross-lagged effect from age 12 to 13 and a non-significant negative cross-lagged effect from age 13 to 15. Developmental relations between externalising and internalising in adolescence have been less well studied; however, most studies seem to indicate that externalising continues to have positive cross-lagged effects on internalising (Beyers & Loeber, 2003; Blain-Arcaro & Vaillancourt, 2017; Klostermann et al., 2016; Lee & Stone, 2012). Some previous studies have suggested that internalising also has positive cross-lagged effects on externalising during this phase of development (Beyers & Loeber, 2003; Bornstein, Hahn, & Haynes, 2010; Lee & Stone, 2012; McLaughlin, Aldao, Wisco, & Hilt, 2014). Only a small number of studies have previously hinted at any potential protective effects of internalising in adolescence (e.g., Masten et al., 2005).

There are several possible explanations for the negative cross-lagged effect observed in adolescence in the current study. In contrast to early onset externalising problems, increases in externalising behaviour in adolescence have been hypothesised to be quite normal and strongly linked to peer influences while internalising problems and attendant social isolation have been proposed to attenuate this peer effect (e.g., Moffitt, 2003). Alternatively, it may be that youth who are high in internalising are more likely to refrain from externalising behaviour because of higher levels of fear of its consequences. This effect may not emerge until adolescence due to a dependence on sufficient maturation of self-regulatory capacities. These explanations are speculative and will require further investigation in future studies.

Overall results were similar across our CLPM and ALT-SR models, however, the value of using the latter to disaggregate between and within-person effects was evident in the discrepancies that did arise. First, the ALT-SR showed that the within-person stability of internalising is low between ages 9 and 10 and that the within-person stability of externalising is low between ages 13 and 15, despite the moderate rank order stability stability observed for both in the CLPM. These periods of within-person instability may reflect the emergence of late childhood-onset anxiety/depression and adolsecent-onset conduct problems respectively. Such transition points may not be detected easily using CLPMs due to a masking by the stability of between-person (rank order) differences: youth may show elevated symptoms relative to their peers across development (a between-person effect); however, their symptoms may not escalate relative to their own baseline until late childhood or adolescent (a within-person effect).

In addition, the ALT-SR suggested a negative cross-lagged effect of externalising at age 13 on internalising at age 15 that was not detected in the CLPM. This negative effect (which occured in the context of negative cross-lagged effects of internalising on externalising) suggests that psychopathology becomes increasingly differentiated in adolescence (e.g., Murray et al., 2016). One possibility is that in adolesecnce, high externalising problems become a more deliberate method of coping with distress that might otherwise be manifested as internalising problems. Further, as externalising problems have been argued to be quite normative in adolescence (Moffitt, 2003), showing an increase in externalising problems relative to one's baseline might indicate adaptive social functioning that would lower the risk of internalising problems. Again, these explanations are speculative and will require further testing in future studies; however, if externalising problems do protect against internalisng problems, it would be worthwhile identifying the mechanisms as this could help inform prevention. For example, if the apparent protective effect of externalising problems reflects a benefit of 'letting off steam' safe and constructive alternatives to acting out could be explored with an adolescent to help replace maladaptive methods of coping.

Finally, our results did not support a gender difference in the developmental relations between externalising and internalising problems. Our gender invariance analysis suggested that differences were limited to some of the residual variances of externalising and internalising and not the autoregressive or cross-lagged parameters. This is consistent with a number of previous studies that have found gender invariance in CLPMs involving externalising and internalising problems (Blain-Arcaro & Vaillancourt, 2017; Burt & Roisman, 2010; Hoglund & Chisholm, 2014; van Lier et al., 2012). Further, among studies that have found gender differences, these have typically been limited to a small subset of the totality of paths tested (e.g., Obradović et al., 2009; van Lier & Koot, 2010) and have not tended to be consisent across studies. Thus, there is no strong evidence for fundamental differences in the developmental relations between externalising and internalising problems across males and females.

Limitations and Future Directions

A limitation of the current study includes the reliance on teacher reports, the only informants for whom data were available for both childhood and adolescence. Though teachers may provide more reliable data in the early years of life, by secondary school teachers may have more limited opportunities to observe youth. Further, the same teachers provided ratings across multiple waves, meaning that associations across these waves may have been inflated relative to the lags where different teachers provided ratings. In addition, our study did not have data on early childhood or adulthood, thus we could not evaluate externalising-internalising developmental dynamics outside the age 7 to 15 range.

It would be valuable for the present study to be replicated in other large longitudinal samples. Many studies with the requisite data exist, including previous developmental cascade studies cited in the current report. In addition, there are a number of additional developmental psychopathology models that potentially imply within-person effects that could be evaluated using the ALT-SR. These include, among others, Patterson's coercion model of the relation between parenting and externalising (Besemer et al., 2016; Patterson, 1982), the ontogenic

model of ADHD-conduct disorder comorbidity (Beauchaine & McNulty, 2013), and the dynamic mutualism model of comorbidity across the spectrum of common mental health problems.

Conclusions

Within-person analyses of the developmental relations between externalising and internalising largely led to the same conclusions as previous studies that have utilised CLPMs. This helps to address concerns that because developmental cascade theories may not be appropriately operationalised in CLPMs their results may not, in fact, provide the assumed level of support for these theories. Our results, however, also highlighted potential mutual antagonism between externalising and internalising states in adolescence.

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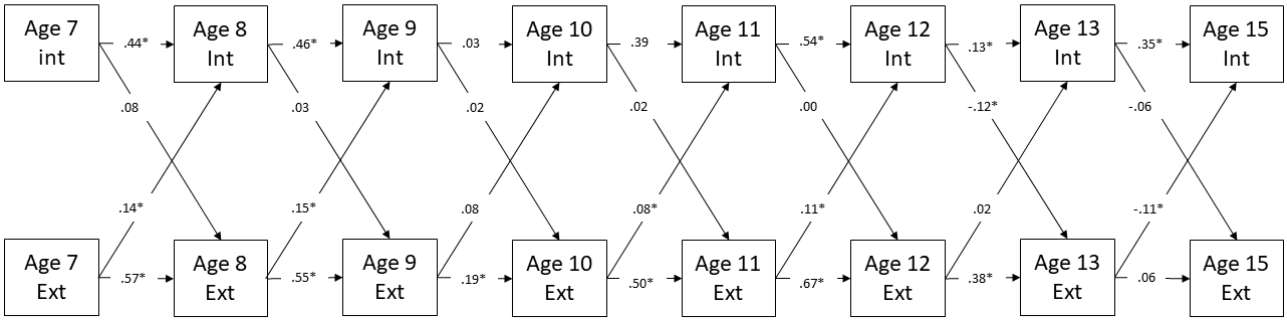
Tables

Table 1: Key ALT-SR and CLPM parameters

	ALT-SR			***CLPM***		
	B	**SE**	***p***	**β**	**SE**	***p***
Autoregressive parameters						
Age 15 externalising on age 13 externalising	.06	0.08	.421	**.47**	0.04	<.001
Age 15 internalising on age 13 internalising	**.35**	0.04	<.001	**.48**	0.03	<.001
Age 13 externalising on age 12 externalising	**.38**	0.08	<.001	**.68**	0.03	<.001
Age 13 internalising on age 12 internalising	**.13**	0.04	.001	**.34**	0.03	<.001
Age 12 externalising on age 11 externalising	**.67**	0.03	<.001	**.78**	0.02	<.001
Age 12 internalising on age 11 internalising	**.54**	0.03	<.001	**.66**	0.02	<.001
Age 11 externalising on age 10 externalising	**.50**	0.04	<.001	**.63**	0.03	<.001
Age 11 internalising on age 10 internalising	**.39**	0.04	<.001	**.55**	0.03	<.001
Age 10 externalising on age 9 externalising	**.19**	0.05	<.001	**.35**	0.04	<.001
Age 10 internalising on age 9 internalising	.03	0.05	.537	**.30**	0.03	<.001
Age 9 externalising on age 8 externalising	**.55**	0.04	<.001	**.66**	0.03	<.001
Age 9 internalising on age 8 internalising	**.46**	0.03	<.001	**.58**	0.03	<.001
Age 8 externalising on age 7 externalising	**.57**	0.04	<.001	**.67**	0.03	<.001
Age 8 internalising on age 7 internalising	.44	0.04	<.001	**.56**	0.03	<.001
Cross-lagged parameters						
Age 15 externalising on age 13 internalising	-.06	0.03	.063	-.02	0.02	.402
Age 15 internalising on age 13 externalising	**-.11**	0.05	.017	.02	0.03	.441
Age 13 externalising on age 12 internalising	**-.12**	0.03	<.001	**-.07**	0.02	<.001
Age 13 internalising on age 12 externalising	.02	0.05	.625	.05	0.03	.187
Age 12 externalising on age 11 internalising	.00	0.02	.91	.01	0.02	.65
Age 11 externalising on age 10 internalising	**.02**	0.03	.462	.02	0.02	.393
Age 11 internalising on age 10 externalising	.08	0.04	.024	**.07**	0.03	.023
Age 12 internalising on age 11 externalising	**.11**	0.04	.008	**.09**	0.03	.004
Age 10 externalising on age 9 internalising	.02	0.03	.635	.00	0.03	.880
Age 10 internalising on age 9 externalising	.08	0.05	.116	.01	0.04	.748
Age 9 externalising on age 8 internalising	.03	0.03	.332	.01	0.03	.825
Age 9 internalising on age 8 externalising	**.15**	0.02	<.001	**.12**	0.03	<.001
Age 8 externalising on age 7 internalising	.08	0.04	.050	.05	0.03	.099
Age 8 internalising on age 7 externalising	**.14**	0.04	<.001	**.10**	0.03	.003

Note. Bold= significant at $p<.05$. ALT-SR=autoregressive latent trajectory model with structured residuals; CLPM= cross-lagged panel model.

Figure 1: Within-person autoregressive and cross-lagged parameters from partially gender-invariant ALT-SR model



Note. *statistically significant at $p<.05$.

Key Points

- Previous evidence has supported developmental cascades from externalising to internalising problems as an explanation for externalising-internalising comorbidity.
- However, there is a need to verify that these cascades reflect the within-person processes implied by theory.
- Using the autoregressive latent trajectory model with structured residuals and 8 waves of longitudinal data, we provided support for this claim.
- We also identified reciprocal negative effects between internalising and externalising in adolescence.
- Results suggest that, externalising and internalising problems may negatively influence one another in adolescence; an observation which may help inform prevention.